Patent Claims

1. A process for producing a borate-containing, low-alkali material, in which a boron-containing melting material is induction-heated directly in an appliance using an alternating electromagnetic field, and in which the melting material includes as a constituent at least one metal oxide, the metal ions of which have a valency of at least two, in a quantitative proportion of at least 25 mol%, and in which the ratio of the molar substance quantities of silicon dioxide to borate in the melting material is less than or equal to 0.5.

2. The process as claimed in claim 1, characterized in that the melt is induction-heated directly using a high-frequency field.

3. The process as claimed in claim 1 or 2, characterized in that the melt is induction-heated directly using an alternating electromagnetic field with a frequency in the range from 50 kHz to 1500 kHz.

4. The process as claimed in one of the preceding claims, characterized in that the borate-containing, low-alkali material comprises a borate-containing material, a borate glass or a borosilicate glass with a high boric acid content.

5. The process as claimed in one of the preceding claims, characterized in that the quantitative proportion of alkali-containing compounds in the melting material is less than 2%, preferably less than 0.5%.

6. The process as claimed in one of the preceding claims, characterized in that the appliance comprises a skull crucible in which the melting material is melted.

7. The process as claimed in claim 6, in which the melting material is melted in a skull crucible, the wall of which comprises cooled tubes which are spaced apart from one another in such a way that the tube walls adopt a spacing of between 2 mm and 4 mm, preferably of 2.5 mm to 3.5 mm.

8. The process as claimed in claim 6 or 7, characterized in that the cooled tubes of the skull crucible are short-circuited in particular in the region of a high-frequency coil for emitting the alternating electromagnetic field.

9. The process as claimed in claim 8, characterized in that the tubes are short-circuited at in each case one location.

10. The process as claimed in claim 8, characterized in that the tubes are in each case short-circuited at their ends.

11. The process as claimed in one of claims 6 to 10, characterized in that the cooled tubes comprise tubes made from platinum, a platinum alloy or aluminum.

12. The process as claimed in one of claims 6 to 11, characterized in that the tubes of the skull crucible are coated with a layer of platinum or a platinum alloy.

13. The process as claimed in one of claims 6 to 12, characterized in that the tubes of the skull crucible

are coated with plastic, in particular with fluorine-containing plastic.

14. The process as claimed in one of the preceding claims, characterized in that batch is added in the form of pellets.

15. The process as claimed in one of the preceding claims, characterized in that the melt is stirred while the batch is being melted down.

16. The process as claimed in one of the preceding claims, characterized in that a gas is blown into the melt.

17. The process as claimed in claim 15 or 16, characterized in that a bubbling tube is introduced into the melt and a gas is blown into the melt through a nozzle of the bubbling tube.

18. The process as claimed in one of the preceding claims, characterized in that the melting material is refined.

19. The process as claimed in claim 18, characterized in that the batch is melted and refined in at least two appliances connected in series.

20. The process as claimed in claim 18, characterized in that batch is melted and refined in the same appliance.

21. The process as claimed in one of the preceding claims, characterized in that the melting material is melted discontinuously in the appliance.

22. The process as claimed in one of the preceding claims, characterized in that the melting material is melted continuously in the appliance.

23. The process as claimed in one of the preceding claims, characterized in that the melting material has a composition in which:

B_2O_3	15 to 75 mol%,
SiO_2	0 to 40 mol%,
Al_2O_3, Ga_2O_3, In_2O_3	0 to 25 mol%,
$\Sigma M(II)O, M_2(III)O_3$	15 to 85 mol%,
$\Sigma M(IV)O_2, M_2(V)O_5, M(VI)O_3$	0 to 20 mol%, and
$\Sigma M(I)_2O$	<0.50 mol% are

present, and in which

$X(B_2O_3)$ is >0.50,

where

$X(B_2O_3) = B_2O_3/(B_2O_3 + SiO_2)$,

M(I) = Li, Na, K, Rb, Cs,

M(II) = Mg, Ca, Sr, Ba, Zn, Cd, Pb, Cu,

M(III) = Sc, Y, $^{57}La-^{71}Lu$, Bi,

M(IV) = Ti, Zr, Hf,

M(V) = Nb, Ta,

M(VI) = Mo, W.

24. The process as claimed in claim 23, characterized in that the B_2O_3 content in the melting material is from 15 to 75 mol% and $X(B_2O_3)$ is >0.52.

25. The process as claimed in claim 23 or 24, in which in the melting material the content of

B_2O_3 is 20 to 70 mol%, the content of

$\Sigma M(II)O, M_2(III)O_3$ is 15 to 80 mol%, and

$X(B_2O_3)$ is >0.55.

26. The process as claimed in one of claims 23 to 25, characterized in that in the melting material the content of

B_2O_3	is 28 to 70 mol%, the content of
$B_2O_3 + SiO_2$	is 50 to 73 mol%, the content of
Al_2O_3, Ga_2O_3, In_2O_3	is 0 to 10 mol%, and the content of
$\Sigma M(II)O, M_2(III)O_3$	is 27 to 50 mol%, and
$X(B_2O)$	is >0.55.

27. The process as claimed in claim 26, characterized in that a composition is selected for the melting material in which:

B_2O_3	36 to 66 mol%,
SiO_2	0 to 40 mol%,
$B_2O_3 + SiO_2$	55 to 68 mol%,
Al_2O_3, Ga_2O_3, In_2O_3	0 to 2 mol%,
$\Sigma M(II)O, M_2(III)O_3$	27 to 40 mol%,
$\Sigma M(IV)O_2, M_2(V)O_5, M(VI)O_3$	0 to 15 mol% are present, and
$X(B_2O_3)$	is >0.65.

28. The process as claimed in one of the preceding claims, in particular for the production of borate glasses and borosilicate glasses with a high boric acid content for optical applications, characterized in that the melting material has the following composition:

B_2O_3	45 to 66 mol%,
SiO_2	0 to 12 mol%,
$B_2O_3 + SiO_2$	55 to 68 mol%,
Al_2O_3, Ga_2O_3, In_2O_3	0 to 0.5 mol%,
$\Sigma M(II)O$	0 to 40 mol%,

$\Sigma M_2(III)O_3$	0 to 27 mol%,
$\Sigma M(II)O, M_2(III)O3$	27 to 40 mol%,
$\Sigma M(IV)O_2, M_2(V)O_5, M(VI)O_3$	0 to 15 mol%, and

in which

$X(B_2O_3)$	is >0.78,

where M(II) = Mg, Ca, Sr, Ba, Zn, Cd, Pb.

29. The process as claimed in one of the preceding claims, in particular for the production of borate glasses and crystallizing boron-containing materials, characterized in that the melting material has a composition in which the following contents are present

B_2O_3	30 to 75 mol%,
SiO_2	<1 mol%,
Al_2O_3, Ga_2O_3, In_2O_3	0 to 25 mol%,
$\Sigma M(II)O, M_2(III)O_3$	20 to 85 mol%, and
$\Sigma M(IV)O_2, M_2(V)O_5, M(VI)O_3$	0 to 20 mol% and

in which

$X(B_2O_3)$	is >0.90.

30. The process as claimed in one of the preceding claims, in particular for producing crystallizing borate-containing material, wherein the melting material has a composition in which

B_2O_3	20 to 50 mol%,
SiO_2	0 to 40 mol%,
Al_2O_3, Ga_2O_3, In_2O_3	0 to 25 mol%,
$\Sigma M(II)O, M_2(III)O_3$	15 to 80 mol%, and
$\Sigma M(IV)O_2, M_2(V)O_5, M(VI)O_3$	0 to 20 mol%, are

present, and in which

$X(B_2O_3)$	is >0.52.

31. The process as claimed in claim 30, characterized in that $X(B_2O_3)$ is >0.55.

32. The process as claimed in claim 30 or 31, characterized in that the quantitative proportions are

$\Sigma M(II)O$	15 to 80 mol%, and
$M_2(III)O_3$	0 to 5 mol%, and
$X(B_2O_3)$	is >0.60.

33. The process as claimed in one of claims 30 to 32, characterized in that the quantitative proportion of substances selected from a group consisting of Al_2O_3, Ga_2O_3 and In_2O_3 does not exceed 5 mol%.

34. The process as claimed in one of claims 30 to 33, characterized in that the composition for the melting material is selected in such a way that the quantitative proportion of substances selected from a group consisting of Al_2O_3, Ga_2O_3 and In_2O_3 does not exceed 3 mol% and in which the quantitative proportion of $\Sigma M(II)O$ is in the range from 15 to 80 mol%, and in which $X(B_2O_3)$ is >0.65, where M(II) = Zn, Pb, Cu.

35. The process as claimed in one of the preceding claims, characterized in that a composition is selected for the melting material in which:

B_2O_3	20 to 50 mol%,
SiO_2	0 to 40 mol%,
Al_2O_3	0 to 3 mol%,
ΣZnO, PbO, CuO	15 to 80 mol%,
Bi_2O_3	0 to 1 mol% and
$\Sigma M(IV)O_2, M_2(V)O_5, M(VI)O_3$	0 to 0.5 mol% are

present, and in which $X(B_2O_3)$ is >0.65.

36. The process as claimed in claim 35, characterized in that a composition is selected for the melting material in which the quantities of substance are

B_2O_3	20 to 42 mol%,
SiO_2	0 to 38 mol%,
ΣZnO, PbO	20 to 68 mol%,
CuO	0 to 10 mol%,
ΣZnO, PbO, CuO	20 to 68 mol%, and
Bi_2O_3	0 to 0.1 mol%, and

in which $X(B_2O_3)$ is >0.65.

37. The process as claimed in one of claims 1 to 36, a composition which is free of PbO and CdO is selected for the melting material.